Duwamish River/Elliott Bay/Green River

Water Column PCB Congener Survey

Sampling and Analysis Plan

Prepared for the

King County Department of Natural Resources and Parks
Wastewater Treatment Division

by the

King County Department of Natural Resources and Parks
Marine and Sediment Assessment Group

August 2005


King County

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1 INTRODUCTION

This sampling and analysis plan (SAP) presents project information and sampling and analytical methodologies that will be employed to perform a survey of polychlorinated biphenyl (PCB) congeners in the water column of the Duwamish River, Elliott Bay, and the Green River. Figures referenced in the SAP narrative are included as Appendix A.

1.1 Project Background

King County completed a Water Quality Assessment (WQA) of the Duwamish River and Elliott Bay in 1999 to evaluate the effects of combined sewer overflows (CSOs) in these water bodies. The Environmental Fluids Dynamic Computer Code (EFDC) model, a hydrodynamic and fate and transport numerical model, was used as part of this assessment to estimate chemical concentrations under conditions both with and without CSO discharges. King County is currently updating the EFDC model, in part, to refine the predictions of total PCB concentrations in the water column of the Lower Duwamish Waterway.

The County collected hundreds of water samples in the Duwamish River and Elliott Bay during the WQA and performed numerous chemical analyses on the samples. Data collection was limited, however, for PCBs. Semi-permeable membrane devices (SPMDs) were used to collect measurements of PCB concentrations in surface waters at two locations in the Duwamish River. The SPMDs were deployed for a two-week period in April 1996 at two depths at each of the stations.

Measurable concentrations of PCB congeners were detected on the SPMDs, however, only a subset of congeners had the appropriate data available for back-calculation and estimation of Duwamish River PCB water concentrations from the SPMD data. As a result, total PCB values may have been underestimated when these data were used to calibrate the model. This has been identified as a data gap in the evaluation of PCBs in the surface waters of the Duwamish River.

PCB analytical techniques have advanced since that time and it is now possible to analyze PCB congeners in whole water samples at picogram per liter (pg/L) concentrations. Given these analytical advances, King County has decided to collect a limited number of water samples in the Duwamish River so that the EFDC model can be re-calibrated for PCBs. Water samples will also be collected in the Green River and Elliott Bay. These two locations will provide information on boundary conditions as well as inputs from freshwater flows and marine tidal flows to the Duwamish River. The County is also collecting data on various conventional parameters as part of their normal marine monitoring program. These data can also be used for the EFDC model updates.

1.2 Survey Scope of Work

This survey will involve collection and analysis of water column samples from four locations in the Duwamish River, Elliott Bay, and the Green River. Samples will be collected from two depths at each of two stations in the Duwamish River; one sample from the salt wedge near the river-bottom and one sample from the surface. Samples will be collected from a single depth at one station each in Elliott Bay and the Green River. The survey will be comprised of four sampling events, each event revisiting the same four stations. Two

sampling events will occur during the low-flow, dry season in late summer/early fall and two sampling events will occur during the higher-flow, wet season in late fall/early winter. All water samples will be analyzed for all 209 PCB congeners and several conventional water quality parameters.

1.3 Survey Schedule

The two dry-weather sampling events will occur in August and September 2005. Sample collection is scheduled to occur on August 22 and September 26. The two wet-weather sampling events will occur in November and December 2005 with specific sample collection dates yet to be determined.

The turn-around time for all analytical data is approximately six weeks from the date of sample collection. It is anticipated that data from the first two sampling events will be validated, reviewed, and ready for release by January 2006. Data from the second two sampling events will be validated, reviewed, and ready for release by April 2006. Data will not be released prior to validation.

2 SURVEY DESIGN

The goal of King County's water column PCB congener survey is to collect dry and wet season water samples in the Duwamish River and its boundary waters in the Green River and Elliott Bay and to analyze these samples for 209 PCB congeners. Resulting data will allow King County to begin characterizing water concentrations of PCB congeners at different locations and depths and to evaluate any differences between locations and depths, both spatially and temporally. The data will also be used to recalibrate the EFDC model for PCBs.

2.1 Data Quality Objectives

The data quality objectives (DQOs) are to collect data of known and sufficient quality to meet the survey goals. Validation of project data will assess whether the data collected are of sufficient quality to meet the survey goals. The data quality issues of precision, accuracy, bias, representativeness, completeness, comparability, and sensitivity are described in the following sections, along with data validation.

2.1.1 Precision, Accuracy, and Bias

Precision is the agreement of a set of results among themselves and is a measure of the ability to reproduce a result. Accuracy is an estimate of the difference between the true value and the determined mean value. The accuracy of a result is affected by both systematic and random errors. Bias is a measure of the difference, due to a systematic factor, between an analytical result and the true value of an analyte. Precision, accuracy, and bias for analytical chemistry may be measured by one or more of the following quality control (QC) procedures:

- analysis of various laboratory QC samples such as blanks, surrogates, and replicates; and
- collection and analysis of field replicate samples.

2.1.2 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at the sampling point, or an environmental condition. Water samples will be collected from stations with predetermined coordinates and sampling depths to represent specific site conditions, both compared to other locations and, eventually, at each location over time.

2.1.3 Completeness

Completeness is defined as the total number of samples analyzed for which acceptable analytical data are generated, compared to the total number of samples submitted for analysis. Sampling at stations with known position coordinates in favorable conditions, along with adherence to standardized sampling and testing protocols will aid in providing a complete set of data for this survey. The goal for completeness is 100%. If 100% completeness is not achieved, the project team will evaluate if the DQOs can still be met or if additional samples may need to be collected and analyzed.

2.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This goal is achieved through using standard techniques to

collect and analyze representative samples, along with standardized data validation and reporting procedures. By following the guidance of this SAP, the goal of comparability between this and future sampling events will be achieved. Historical data from the survey area may be compared with data generated from this survey to enhance data analysis efforts. Previous data will be used if comparable sampling and/or analytical techniques were employed.

2.1.5 Sensitivity

Sensitivity is a measure of the capability of analytical methods to meet the survey goal. SPMD results from the WQA indicated that PCB congeners were detected in the Duwamish River at low pg/L concentrations. The analytical method detection limits presented in Section 5 are sensitive enough to detect PCB congeners at these concentrations in whole water samples.

2.1.6 Data Validation

PCB congener data generated during this survey will be validated according to accepted Environmental Protection Agency (EPA) guidelines (EPA 2001). The analytical laboratory will supply data packages that will allow complete data validation under EPA guidance. Associated conventional water quality data will be validated against requirements of the reference methods as well as the requirements of this SAP.

2.2 Sampling and Analytical Strategy

The survey goal, staff and vessel availability, laboratory capacity, and cost were all taken into consideration when this survey was designed. King County conducts a routine marine water column monitoring program that collects monthly samples from prescribed stations in central Puget Sound, Elliott Bay, and the Duwamish River. The water column PCB congener survey will be conducted as an adjunct to the marine monitoring program, with survey samples collected concurrently with other data gathering efforts at one existing station in Elliott Bay and two existing stations in the Duwamish River. Sampling at the Green River station will be conducted separately but concurrently with sampling at the other three stations.

Four sampling events will comprise this survey and will provide enough data to meet the survey goal while minimizing costs and impacts to staff and vessel time and laboratory capacity. Two sampling events will be conducted during the dry, low-flow season in late summer and early fall. Another two sampling events will be conducted during the wet, higher-flow season in late fall and early winter. Samples will be collected at all four stations during each sampling event and all samples will be submitted for PCB congener and conventional water quality analyses.

Samples will be collected from two depths at the Duwamish River stations; one meter below the surface and one meter above the bottom. This should allow a comparison of PCB congener concentrations between the outflowing fresh river water or mixed upper layer and the underlying salt wedge. Samples will be collected from a depth of 15 meters below the surface at the Elliott Bay Station. The 15-meter depth at the Elliott Bay station is a standard sampling depth for King County's routine water column monitoring program and is representative of marine water that would enter the Duwamish River in the salt wedge.

Samples will be collected from a depth of one meter below the surface at the Green River Station and is representative of background fresh water flowing downstream through the Duwamish River. One field replicate sample will be collected; thus, a total of seven water samples will be submitted for analysis during each sampling event.

In addition to analysis of PCB congeners, numerous conventional parameters will be analyzed to provide data that will facilitate evaluation of PCB partitioning in the water column and will be used in the EFDC model.

2.2.1 Location of Sampling Stations

Sampling station locations are shown in Figure 1 (Appendix A). Station LTED04 is located in central Elliott Bay. Station LTKE03 is located in the Duwamish River at the southern (upstream) end of Harbor Island. Station LTUM03 is also located in the Duwamish River, near the 16th Avenue South Bridge. Station TGS/1 is located in the Green River – this station will be sampled from the entry bridge into Fort Dent Park in Tukwila. Table 1 shows the station coordinates, sampling depths, and water matrices that will be sampled.

Table 1
Station Coordinates, Sampling Depths, and Matrices

Station	Northing[1]	Easting[1]	Depth	Matrix
LTED04	224199	1264780	15 meters below surface	Salt Water
LTKE03	211418	1265871	1 meter below surface	Fresh/Brackish Water
LTKE03	211418	1265871	1 meter above bottom	Salt Water
LTUM03	196629	1274591	1 meter below surface	Fresh/Brackish Water
LTUM03	196629	1274591	1 meter above bottom	Salt Water
TGS/1	173862	1290289	1 meter below surface	Fresh Water

[1]North American Datum 1983 (NAD83)

2.2.2 Sample Acquisition and Analytical Parameters

Sampling at Stations LTED04, LTKE03, and LTUM03 will be conducted onboard King County's research vessel *Liberty* using standardized shipboard water column sampling techniques. Sampling at Station TGS/1 will be conducted from the bridge in Fort Dent Park using standardized manual water sampling techniques. Sampling techniques are discussed in Section 3.

Each sample will be analyzed for 209 PCB congeners along with the following conventional parameters; dissolved organic carbon (DOC), total organic carbon (TOC), total dissolved solids (TDS), total suspended solids (TSS), and total suspended solids, .45 microns (TSS45). PCB congener analysis will be conducted by Axys Analytical in Sidney, British Columbia. All conventional analyses will be conducted by the King County Environmental Laboratory.

3 SAMPLING PROCEDURES

This section describes the sampling procedures, both offshore and on land, that will be followed over the course of all four sampling events to meet the survey DQOs of representativeness, comparability, and completeness. All sampling activities will be conducted according to the regionally-accepted guidance found in the Puget Sound Estuary Program's (PSEP) Puget Sound Protocols (PSEP 1997, 1998).

3.1 Station Positioning

A precise method of station positioning is important for surveys in which sampling stations will be revisited multiple times. The water column PCB congener survey will not only assess spatial differences in water column PCB concentrations but temporal differences at each station as well. In order to assess temporal changes in the water column, the station must be revisited as precisely as possible.

Station positioning for Stations LTED04, LTKE03, and LTUM03 will be accomplished using a shipboard Differential Global Positioning System (DGPS). Prior to the survey, the prescribed station coordinates will be loaded into the *Liberty's* DGPS computer. During the sampling event, the shipboard navigational system will utilize the differential data transmissions from regional Coast Guard base stations to automatically correct its GPS satellite data. The GPS antenna is boom-mounted above the sampler descent line to achieve a more accurate coordinate fix above the sampling point. Previous DGPS usage indicates that an average precision of one to two meters can usually be attained.

Station TGS/1 will be accessed by foot rather than boat. Samples at Station TGS/1 will be collected from a known position; the center of the entry bridge into Fort Dent Park.

3.2 Sample Collection

Samples will be collected from Stations LTED04, LTKE03, and LTUM03 with Niskin® bottles deployed on a conductivity/temperature/depth (CTD) rosette array from the *Liberty*. Samples will be collected from Station TGS/1 with a Scott (Van Doren®-style) bottle deployed manually from a bridge.

At Stations LTED04, LTKE03, and LTUM03, the CTD will be programmed with the prescribed sampling depths prior to deployment. The CTD is deployed and allowed to equilibrate for approximately five minutes at the surface before its descent. The CTD is deployed at a controlled descent rate, both on the downcast and the upcast. The discrete samples are collected during the upcast at the prescribed depths when the instrument triggers the Niskin® bottles to close. Upon retrieval of the CTD after each deployment, the sample aliquots will be immediately transferred to the appropriate pre-cleaned, sample containers.

At Station TGS/1, sampling personnel will deploy the Scott bottle manually by rope from the sampling point on the bridge to a depth of approximately one meter below the surface of the river. The Scott bottle is then closed by releasing a "messenger" weight that travels down the rope and trips the closure mechanism. Upon retrieval, sample aliquots again will immediately be transferred to the pre-cleaned sample containers.

3.3 Sample Delivery and Storage

All samples will be kept in ice-filled coolers until delivery to the King County Environmental Laboratory, on the same day that they were collected. Sample preservation, if required, will be performed upon receipt of the samples at the King County Environmental Laboratory. PCB congener samples will be shipped the following day to Axys Analytical via overnight express delivery service. Table 2 shows sample handling and storage requirements.

Table 2
Sample Container, Preservation, Storage, and Hold Time Requirements

Analyte	Container	Preservation	Storage	Hold Time
Dissolved Organic Carbon	125-ml amber HDPE	H_3PO_4 to pH<2[1]	refrigerate at 4°C	28 days
Total Organic Carbon	2 x 40-ml amber VOA	H_3PO_4 to pH<2	refrigerate at 4°C	28 days
Total Dissolved Solids	500-ml clear HDPE	None	refrigerate at 4°C	7 days
Total Suspended Solids	1-L clear HDPE	None	refrigerate at 4°C	7 days
Total Suspended Solids .45µ	1-L clear HDPE	None	refrigerate at 4°C	7 days
PCB Congeners	2 x 1-L amber glass	H_2SO_4 to pH 2-3	refrigerate at 4°C[2]	1 year

[1]Within 24 hours of collection, samples must be filtered (.45 µ) prior to preservation.
[2]Must be refrigerated in the dark.

3.4 Chain of Custody

Chain of custody (COC) will commence at the time that each sample is collected. While in the field, all samples will be under direct possession and control of King County field staff. For chain of custody purposes, the research vessel and locked field vehicle will be considered a "controlled area." All sample information will be recorded on a COC form (Figure 2). This form will be completed in the field and will accompany all samples during transport and delivery to the laboratory. Upon arrival at the King County Environmental Laboratory, the sample delivery person(s) will relinquish samples to the sample login person. The date and time of sample delivery will be recorded and both parties will then sign off in the appropriate sections on the COC form at this time. Once completed, original COC forms will be archived in the project file.

Samples delivered after regular business hours will be stored in a refrigerator until the next day. Samples delivered to Axys Analytical will be accompanied by a properly-completed King County Environmental Laboratory COC form and custody seals will be placed on the shipping cooler. Axys Analytical will be expected to provide a copy of the completed COC form as part of their analytical data package.

3.5 Sample Documentation

Sampling information and sample metadata will be documented using the methods noted below.

- Field sheets generated by King County's Laboratory Information Management System (LIMS) will be used at all stations and will include the following information:
  1. sample ID number
  2. station name
  3. station water column depth (except Station TGS/1)
  4. sample depth
  5. date and time of sample collection

6. condition and height of tide (except Station TGS/1)
7. initials of all sampling personnel

- LIMS-generated container labels will identify each container with a unique sample number, station and site names, collect date, analyses required, and preservation method.
- The *Liberty's* logbook will contain records of all shipboard activities, destinations, arrival and departure times, general weather and positioning information, and the names of shipboard personnel for Stations LTED04, LTKE03, and LTUM03.
- The *Liberty's* cruise plan will list the prescribed stations to be sampled, along with their respective coordinates and other associated locating information.
- Electronic DGPS coordinate data will be electronically logged for each sample using both latitude/longitude and NAD 83 State Plane formats.
- COC documentation will consist of the Lab's standard COC form, which is used to track release and receipt of each sample from collection to arrival at the lab.

3.6 Field Measurements

Continuous *in situ* water quality data will be automatically measured and recorded during deployment of the CTD at Stations LTED04, LTKE03, and LTUM03. These additional parameters include temperature and salinity. Water temperature at Station TGS/1 will be manually measured and recorded at the time of sample collection.

3.7 Field Replicates

One field replicate will be collected during each sampling event and analyzed for all target parameters. Field replicates will be collected from the following stations during the four sampling events:

- August 2005 – Station LTUM03 at a depth of one meter below the surface;
- September 2005 – Station TGS/1 at a depth of one meter below the surface; and
- November 2005 – Station LTED04 at a depth of 15 meters below the surface.
- December 2005 – Station LTKE03 at a depth of one meter above the bottom

Each field replicate will be collected as a separate deployment of the sampling equipment; either the CTD/Niskin® bottle array at Stations LTED04, LTKE03, and LTUM03, or the hand-lowered Scott bottle at Station TGS/1.

4 ANALYTICAL METHODS AND DETECTION LIMITS

Analytical methods for PCB congener and conventional analyses are presented in this section, along with analyte-specific detection limits. The terms MDL and RDL, used in the following subsections, refer to *method detection limit* and *reporting detection limit*, respectively. The MDL is defined as *the minimum concentration of a chemical constituent that can be detected*, while the RDL is defined as *the minimum concentration of a chemical constituent that can be reliably quantified*. Note that PCB congener data will be reported with MDL values only.

4.1 PCB Congeners

PCB congener analysis will follow Environmental Protection Agency (EPA) Method 1668A (EPA 1999), which is a high-resolution gas chromatography/high-resolution mass spectroscopy (HRGC/HRMS) method using an isotope dilution internal standard quantification. This method provides reliable analyte identification and very low detection limits. An extensive suite of labeled surrogate standards (Table 3) is added before samples are extracted. Data are recovery-corrected for losses in extraction and clean-up, and analytes are quantified against their labeled analogues.

Axys Analytical will perform this analysis according to their Standard Operating Procedure *MLA-010 Analytical Method for the Determination of 209 PCB Congeners by EPA Method 1668*, which is a proprietary document. The analytical procedure is summarized in the flow chart shown in Figure 4. A one-liter sample will be extracted followed by standard method clean-up, which includes layered Acid/Base Silica, Florisil and Alumina. Analysis is performed with an SPB Octyl column and a secondary DB1 column is used to resolve the co-eluting congeners PCB156 and PCB157.

Table 3

EPA 1668A Labeled Surrogates and Recovery Standards Used for PCB Congener Analysis

Labeled (L) ^{13}C PCB Congener Surrogate Standards				
1L	37 L	123 L	155 L	202 L
3 L	54 L	118 L	167 L	205 L
4 L	81 L	114 L	156/157 L	208 L
15 L	77 L	105 L	169 L	206 L
19 L	104 L	126 L	188 L	209 L
Cleanup Standards				
28 L	111 L	178 L		
Internal (Recovery) Standards				
9 L	52 L	101 L	138 L	194 L

In addition to the surrogate, cleanup, and internal standards, which assess laboratory accuracy and bias and are part of the quality control for the analysis of every sample, a method blank, laboratory duplicate, and an ongoing precision and recovery sample will be analyzed with each set of seven samples. Note that a matrix spike and matrix spike duplicate are not required under Method 1668A.

- A **method blank** is an aliquot of a clean reference matrix (deionized, distilled water for water samples) that is processed through the entire analytical procedure. Analysis of

method blanks is used to evaluate the levels of contamination that might be associated with the processing and analysis of samples in the laboratory and introduce bias into the sample result. Method blank results for all target analytes should be "less than the MDL." Method 1668A has specific requirements for method blanks that must be met before sample data can be reported (see section 9.5.2 of Method 1668A).

- A **laboratory duplicate** is a second aliquot of sample matrix that is collected concurrently with the original sample aliquot. The laboratory duplicate is processed through the entire analytical procedure along with the original sample in the same quality control batch. Laboratory duplicate results are used to assess the precision of the analytical method and the relative percent difference between the results should be within method-specified or performance-based quality control limits.
- An **ongoing precision and recovery (OPR) sample** is to be analyzed with each QC sample batch. The OPR samples must show acceptable recoveries, according to Method 1668A, in order to samples to be analyzed and data to be reported.

Table 4 lists the 209 PCB congeners and their respective MDL values. Note that several of the congeners co-elute and a single MDL value is provided for the multiple congeners.

4.2 Conventionals

All conventional analyses will follow Standard Methods (SM) protocols (American Public Health Association [APHA] 1998). Table 5 presents the analytical methods, detection limits and units for conventional analyses.

Table 5
Conventionals Analytical Methods and Detection Limits

Analyte	Method	MDL	RDL	Units
Dissolved Organic Carbon	SM5310-B	0.5	1.0	mg/L
Total Organic Carbon	SM5310-B	0.5	1.0	mg/L
Total Dissolved Solids	SM2540-C	20	40	mg/L
Total Suspended Solids	SM2540-D	0.5	1.0/10[1]	mg/L
Total Suspended Solids, .45µ	SM2540-D	0.5	1.0/10[1]	mg/L

[1]RDL is 1.0 mg/L for fresh water samples and 10 for salt water samples.

Dissolved and total organic carbon will be analyzed according to SM5310-B, which is a high-temperature combustion with infrared spectroscopy. Total dissolved solids will be analyzed according to SM2540-C, which is a gravimetric determination. Both total suspended solids analyses will be performed according to SM2540-D, which is also a gravimetric determination.

Quality control samples analyzed in association with conventional analyses will include method blanks, laboratory duplicates, and matrix spikes (dissolved and total organic carbon only). Conventional QC samples will be analyzed at the frequency of one per QC batch, which will generally be seven samples for each sampling event during this survey.

- A **method blank** is an aliquot of a clean reference matrix (deionized, distilled water for water samples) that is processed through the entire analytical procedure. Analysis of method blanks is used to evaluate the levels of contamination that might be associated with the processing and analysis of samples in the laboratory and introduce bias into the

sample result. Method blank results for all target analytes should be "less than the MDL" for all conventional analyses.

- A **laboratory duplicate** is a second aliquot of sample matrix that is processed through the entire analytical procedure along with the original sample in the same quality control batch. For conventional analyses, the laboratory duplicate aliquots are all analyzed on matrix taken from a single sample container, with the exception of TOC. Laboratory duplicate results are used to assess the precision of the analytical method and the relative percent difference of the results should be within method-specified or performance-based quality control limits.
- A **matrix spike** is a known concentration of one or more target analytes, which is introduced into a second aliquot of one analytical sample. The spiked sample is processed through the entire analytical procedure. Analysis of the matrix spike is used as an indicator of sample matrix effect on the recovery of target analytes and, thus, potential bias introduced into the sample results. Quality control limits are based on the percent recovery of the spiked compounds and are either method-specific or performance-based.

5 DATA VALIDATION, REPORTING, AND RECORD KEEPING

5.1 Data Validation

Data validation is critical for evaluating how well analytical data meet project DQOs. Data validation is performed, at some level, during several steps in the process of sample analysis. Final data validation will be performed by the King County project manager for this survey by reviewing complete data packages supplied both by Axys Analytical and the King County Environmental Laboratory. PCB congener analytical data from this survey will be validated according to EPA protocols (EPA 2001), as appropriate. EPA data validation guidelines are not available for conventional water quality data. Conventional data will be validated against reference method requirements and the QC requirements provided in this SAP. Data validation memoranda will be produced and maintained along with the analytical data as part of the project records. PCB congener data will be flagged as appropriate according to EPA data validation guidance.

5.2 Reporting

All data and supporting information will be available for review upon request. Analytical data reports may be requested, either in hard copy or electronic formats, in Microsoft Excel® spreadsheets. Data validation memoranda will be available, either hard copy or electronically, in Microsoft Word® format. All other project information will be available for review in hard copy only.

5.3 Record Keeping

All hard-copy field sampling records, custody documents, raw lab data, and laboratory summaries and narratives will be archived according to King County Environmental Laboratory policy, for a minimum of 10 years from the date samples were collected. These records will include both hard copy and electronic data received from Axys Analytical. Conventional analytical data produced by the King County Environmental Laboratory will be maintained on its LIMS database *in perpetuity*. It is not anticipated, at this time, that the PCB congener data produced by Axys Analytical will be loaded onto the LIMS database.

6 REFERENCES

APHA 1998. *Standard Methods for the Examination of Water and Wastewater, 20th Edition.* American Public Health Association. Washington, D.C.

EPA 1999. *Method 1668, Revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS*. EPA No. EPA-821-R-00-002. United States Environmental Protection Agency, Office of Water. Washington, D.C.

EPA 2001. *USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review*. United States Environmental Protection Agency. Washington, D.C.

PSEP 1997. *Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound.* Prepared for the Puget Sound Estuary Program (U.S. Environmental Protection Agency Region 10) by the King County Environmental Laboratory. Seattle, Washington.

PSEP 1998. *Recommended Guidelines for Station Positioning in Puget Sound.* Prepared for the Puget Sound Estuary Program (U.S. Environmental Protection Agency Region 10) by the King County Environmental Laboratory. Seattle, Washington

APPENDIX A – FIGURES

Figure 1
Water Column PCB congener Survey Sampling Locations

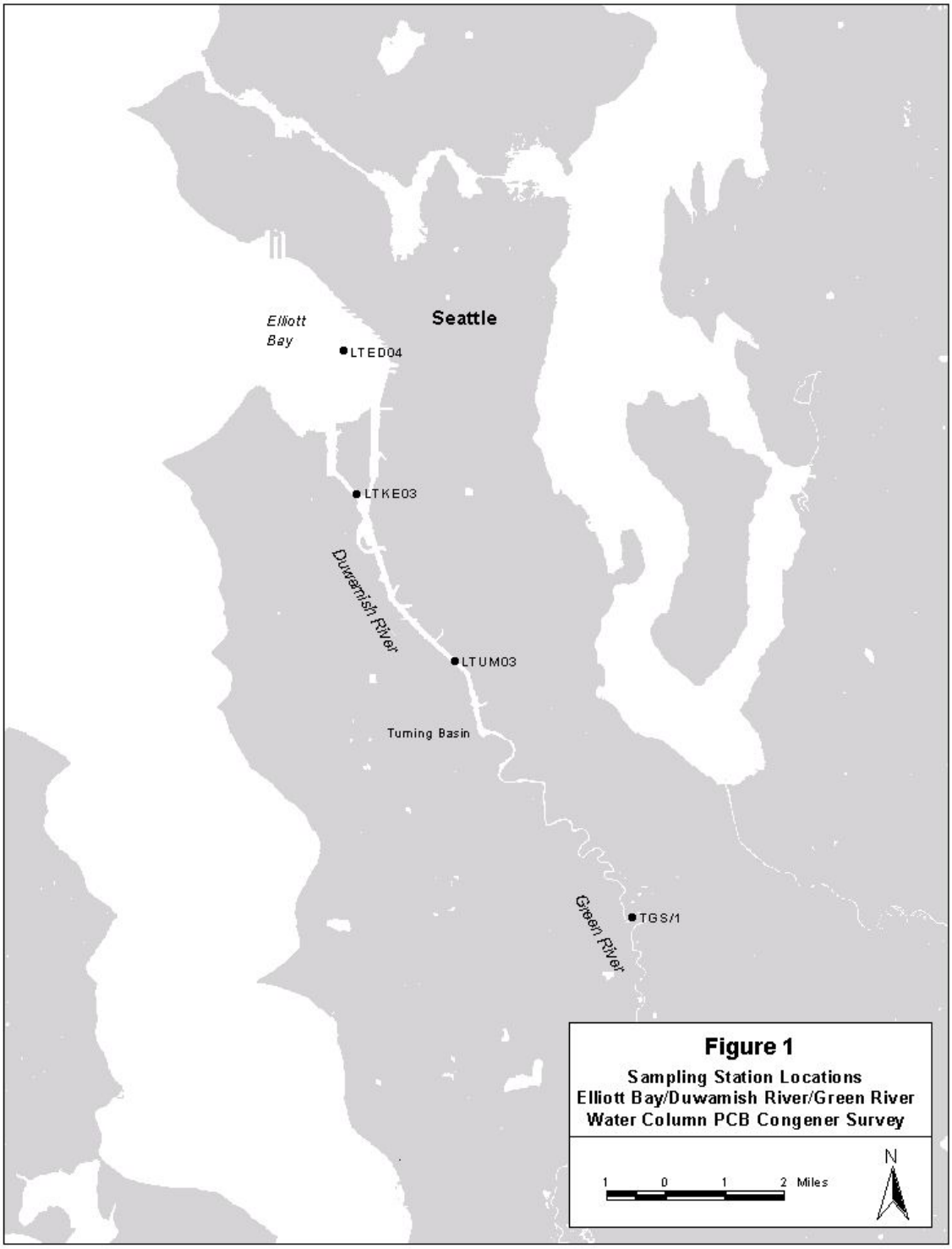

Figure 2
King County Environmental Laboratory Chain of Custody Form

LABORATORY WORK ORDER
Chain of Custody

King County Department of Natural Resources
Water and Land Resources Division
Environmental Laboratory
322 West Ewing Street
Seattle, Washington 98119-1507

Project Name:
Project Number:
Laboratory Project Manager:
Telephone Number:

				Analyses															
Sample Number	Locator	Collect Date	Collect Time	BNAS	BUTYLTIN	CHLOROBENZENES	METHYL MERCURY	PCBS	METALS - ICP	MERCURY - CVAA	AMMONIA	OIL & GREASE	PSD	TOC	SOLIDS	SULFIDE		Number of Containers	Comments

Additional Comments: **Total Number of Containers** **Sampled By:**

Relinquished By:		**Received By:**	
Signature	Date	Signature	Date
Printed Name	Time	Printed Name	Time
Organization		Organization King County Environmental Laboratory	

Figure 3
King County Environmental Laboratory Standard Field Sheet

Fieldsheet ID: 421235_22JUN1999_101133 Page: 1

MAJOR LAKES (wtr col)

Project Number: 421235 Personnel: _____

Sample Number	P15790-1	P15790-2	P15790-3
Locator	0618	0623	0625
Short Loc. Desc.		Rosemnt SD	Sammslough
Locator Desc.		LAKE SAMM/WEST SHORE-ROSEMONT STOR	Lake Sammamish
Site	MAJOR LAKES	MAJOR LAKES	MAJOR LAKES
Sample Depth			
Collect Date			
Comments			
EH, FIELD			
SED DEPTH			
SED SAMP RANGE			
SED TYPE			
TIME			
Dept., Matrix, Prod			
	3 FRSHWTRSED AVS	3 FRSHWTRSED AVS	3 FRSHWTRSED AVS
	3 FRSHWTRSED NH3	3 FRSHWTRSED NH3	3 FRSHWTRSED NH3
	3 FRSHWTRSED PSD	3 FRSHWTRSED PSD	3 FRSHWTRSED PSD
	3 FRSHWTRSED TOC	3 FRSHWTRSED TOC	3 FRSHWTRSED TOC
	3 FRSHWTRSED TOTP	3 FRSHWTRSED TOTP	3 FRSHWTRSED TOTP
	3 FRSHWTRSED TOTS	3 FRSHWTRSED TOTS	3 FRSHWTRSED TOTS
	3 FRSHWTRSED TOTSULFIDE	3 FRSHWTRSED TOTSULFIDE	3 FRSHWTRSED TOTSULFIDE
	6 FRSHWTRSED HG-CVAA	6 FRSHWTRSED HG-CVAA	6 FRSHWTRSED HG-CVAA
	6 FRSHWTRSED PP ICPMS	6 FRSHWTRSED PP ICPMS	6 FRSHWTRSED PP ICPMS
	7 FRSHWTRSED BNA	7 FRSHWTRSED BNA	7 FRSHWTRSED BNA
	7 FRSHWTRSED CHLOROBENZENES	7 FRSHWTRSED CHLOROBENZENES	7 FRSHWTRSED CHLOROBENZENES
	7 FRSHWTRSED CLPESTPCB	7 FRSHWTRSED CLPESTPCB	7 FRSHWTRSED CLPESTPCB
	7 FRSHWTRSED HERB	7 FRSHWTRSED HERB	7 FRSHWTRSED HERB
	7 FRSHWTRSED OPPEST	7 FRSHWTRSED OPPEST	7 FRSHWTRSED OPPEST
	7 FRSHWTRSED TRIBUTYLTIN	7 FRSHWTRSED TRIBUTYLTIN	7 FRSHWTRSED TRIBUTYLTIN
	7 FRSHWTRSED WTPH-HCID	7 FRSHWTRSED WTPH-HCID	7 FRSHWTRSED WTPH-HCID

End of Fieldsheet.

Figure 4
EPA 1668A Procedure for HRGC/HRMS PCB Congeners